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Protecting Animals During Shipment in Aircraft Baggage/Cargo Holds

This tip sheet provides general information and precautions to help assure humane transport and good arrival condition of animals shipped in the lower cargo compartments of airplanes. Many types of animals are shipped in the lower baggage/cargo compartments of aircraft. With few exceptions, there is limited temperature control and very little ventilation in these lower cargo holds. Usually there is only enough ventilation capacity for a few household pets. If too many animals are loaded in a lower compartment, they may suffer or die from heat or cold stress or suffocation.

In most cases, animal stress or loss could be averted by (1) a better understanding of the ventilation capabilities of aircraft cargo compartments, (2) knowledge of the heat output of various types of animals, and (3) improved ground handling and loading procedures.

Ventilation in Aircraft Baggage/Cargo Holds

There are several classes of lower aircraft compartments, but class "D" is most commonly used for baggage and live animal cargo. Class D compartments are designed with little or no positive ventilation, so that if a fire breaks out it will extinguish itself in a matter of seconds due to lack of oxygen.

Some airline literature and personnel will indicate that the baggage compartments are pressurized the same as the passenger compartments. Although this is true, such compartments do not necessarily have their own ventilation systems.

Usually the ventilation in class D compartments is limited to the migration of small amounts of air from the main deck to replace air that leaks from the cargo bay door seals. Some class D compartments are heated with hot air or electric blankets in the walls. Few older models of aircraft have thermostatic temperature control in their lower compartments.

Positive ventilation and temperature control are standard equipment on some newer models of aircraft. These features are also optional on most aircraft at the time of manufacture or during factory overhaul. However, unless assured otherwise by the carrier, shippers should assume that limited ventilation is available when animals are shipped in the lower compartments of airplanes. Figure 1 shows the location of the baggage/cargo compartments on the more commonly used aircraft. Table 1 lists the classification codes and ventilation characteristics of these baggage/cargo compartments.

Animal Heat Output

Lack of consideration for the amount of heat produced by live animals is a major factor leading to animal losses in baggage/cargo compartments of aircraft. Table 2 shows the heat output of various types and sizes of animals.

Generally, the smaller the animal, the greater the heat produced per unit of live weight. Many tragic losses have occurred because this factor was neglected when shipments were planned. Table 2 shows that 100 pounds of pigeons or pet

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birds will produce more heat than a 1,000-pound horse. One thousand pounds of pigeons will produce 38,000 Btu's of heat per hour--the equivalent of a small household furnace. Furthermore, approximately one-third of the total heat produced by live animals is latent. This latent or evaporative heat--plus carbon dioxide--has to be ventilated in order for an animal's natural cooling mechanisms to work. For example, on a pound-for-pound basis, baby chicks require three times more air volume than humans to supply their oxygen needs. High heat production plus oxygen depletion in a small, practically air-tight compartment will lead to rapid suffocation, especially if an aircraft is on the ground in hot weather with the cargo bay doors closed.

Preplan to Protect Your Animals During Air Shipment

Tell airline cargo personnel or your freight forwarder about any special requirements of your animals. Determine the type of aircraft in which your animals will travel and then refer to table 1 to determine the type of lower compartments available for live animals in that aircraft. If compartments are available with air conditioning and positive ventilation, ask that your animals be shipped these compartments.

Whenever more than a few animals are shipped, use table 2 to approximate the total heat production of your shipment. Show these total heat calculations to the air cargo manager so you can receive assurance of adequate ventilation and cooling before booking the shipment. Large shipments should be split or, preferably, shipped on the main deck of a freighter, especially if only class D compartments are available.

Try to schedule your shipment on a flight with as little ground layover time as possible. During extended layovers in hot weather, the cargo bay doors should be opened and ground air conditioning introduced.

In warm weather, try to schedule night or early morning departures and arrivals so the animals will be loaded and handled during periods of cool ambient temperatures and out of direct sunlight. In cold weather, keep the animals in draft-free and adequately heated areas in the cargo terminal. Handle animals expeditiously during loading.

Make sure the containers you use comply with applicable regulations and are designed to allow adequate ventilation for the animals inside. Container ventilation requirements for cats, dogs and laboratory animals are specified by USDA's Animal and Plant Health Inspection Service (see the code of Federal Regulations, Title 9, Animals and Animal Products, Parts 1 to 199). Containers, boxes or crates carrying live animals should never be loaded inside enclosed airline containers or igloos.

Weight and balance requirements have priority during the loading of aircraft. However, to the extent possible, keep animal shipments away from the doors because these areas may be extremely cold and drafty during the flight. Also, do not load containers of animals, particularly baby chicks, directly against walls that may adsorb heat from the containers and chill the animals. Do not stack containers of animals tightly together or against other cargo. Always leave adequate space for ventilation around the containers. Do not ship animals in holds containing a large amount of cargo cooled with dry ice, since the carbon dioxide generated will reduce the oxygen level in the hold.

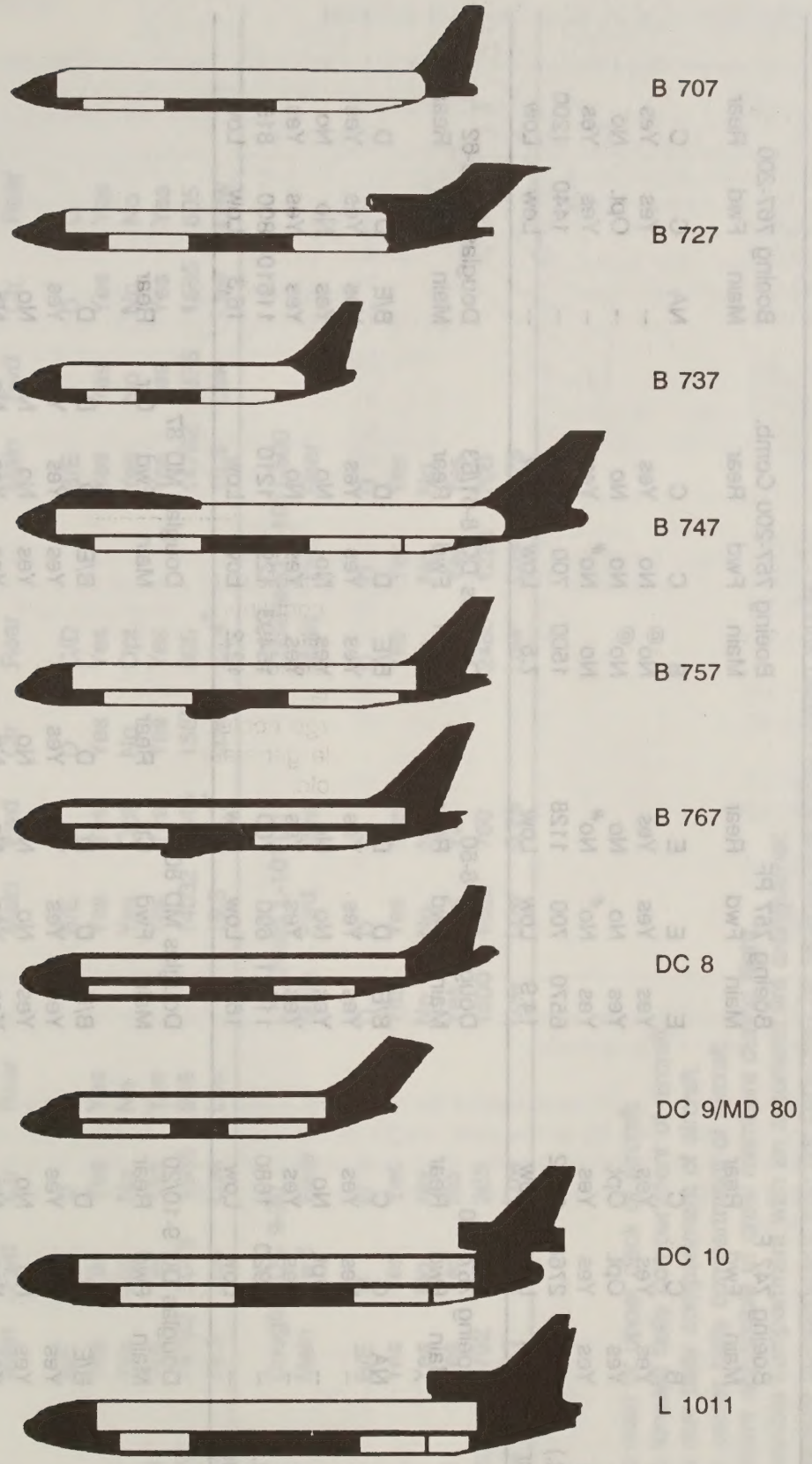

Figure 1. Cargo compartment locations in commonly used aircraft.

Table 1. Classification Codes and Ventilation Characteristics of Cargo Holds in Commonly Used Aircraft.

	Boeing 707-320 C			Boeing 727-200 F			Boeing 727-100 C			Boeing 737-200 C		
	Main	Fwd	Rear	Main	Fwd	Rear	Main	Fwd	Rear	Main	Fwd	Rear
Classification	B/E	B/D	D	E	D	D	B/E	D	D	B/E	D	D
Heating	Yes	Opt.	Opt.	Yes	No	Yes	Yes	No	No	Yes	No	No
Cooling	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No	No
Thermostatic control	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No	No
Cargo volume (cu. ft.)	5693	875	910	4022	710	765	3177	420	470	2730	370	505
Air changes per hour	24.0	Low	Low	18.8	Low	Low	25.9	Low	Low	22.7	Low	Low

	Boeing 747 F			Boeing 757 PF			Boeing 757-200 Comb.			Boeing 767-200		
	Main	Fwd	Rear	Main	Fwd	Rear	Main	Fwd	Rear	Main	Fwd	Rear
Classification	B	C	C	E	E	E	B	C	C	NA	C	C
Heating	Yes	Yes	Yes	Yes	Yes	Yes	No[@]	No	Yes	--	Yes	Yes
Cooling	Yes	Opt.	Opt.	Yes	No	No	No[@]	No	No	--	Opt.	No
Thermostatic control	Yes	Yes	Yes	Yes	No[#]	No[#]	No	No[#]	Yes	--	Yes	Yes
Cargo volume (cu. ft.)	18270	2768	2422	6570	700	1128	1500	700	1090	--	1440	1200
Air changes per hour	33.1	Low	Low	14.9	Low	Low	7.5	Low	Low	--	Low	Low

	Boeing 767-300			Douglas DC 8-50			Douglas DC 8-61/63			Douglas DC 8-62		
	Main	Fwd	Rear	Main	Fwd	Rear	Main	Fwd	Rear	Main	Fwd	Rear
Classification	NA	C	C	B/E	D	D	B/E	D	D	B/E	D	D
Heating	--	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cooling	--	Opt.	No	Yes	No	No	Yes	No	No	Yes	No	No
Thermostatic control	--	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Cargo volume (cu. ft.)	--	1920	1680	11521	690	700	15493	1290	1210	11610	800	815
Air changes per hour	--	Low	Low	16.4	Low	Low	12.2	Low	Low	16.3	Low	Low

	Douglas DC 9-10/20			Douglas MD 80				Douglas MD 87			
	Main	Fwd	Rear	Main	Fwd	Ctr	Rear	Main	Fwd	Ctr	Rear
Classification	B/E	D	D	B/E	D	D	D	B/E	D	D	D
Heating	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cooling	Yes	No	No	Yes	No	No	No	Yes	No	No	No
Thermostatic control	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	No	No
Cargo volume (cu. ft.)	3449	410	267	6107	530	408	502	5095	318	426	369
Air changes per hour	23.3	Low	Low	19.2	Low	Low	Low	23.0	Low	Low	Low

Table 1. Classification Codes and Ventilation Characteristics of Cargo Holds in Commonly Used Aircraft (cont'd).

	Douglas DC 10-40				Douglas DC 10-10/30 (upper galley type)				Douglas DC 10-10/30 (lower galley type)			
	Main	Fwd	Ctr	Rear	Main	Fwd	Ctr	Rear	Main	Fwd	Ctr	Rear
Classification	B/E	C	D	D	B/E	C	D	C/D	B/E	D	D	D
Heating	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cooling	Yes	No	No	No	Yes	Opt.	No	Opt.	Yes	No	No	No
Thermostatic control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cargo volume (cu. ft.)	14782	3045	1585	805	14032	3045	1585	805	14782	1375	1585	805
Air changes per hour	19.3	Low	Low	Low	19.3	18.7*	Low	22.4*	19.3	Low	Low	Low

	Douglas DC 9-30			Lockheed L-1011-1			Lockheed L-1011-500		
	Main	Fwd	Rear	Main	Fwd	Rear	Main	Fwd	Rear
Classification	B/E	D	D	D	D	D	D	D	D
Heating	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cooling	Yes	No	No	No	No	No	No	No	No
Thermostatic control	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Cargo volume (cu. ft.)	4792	607	365	1600	1600	700	2480	1220	700
Air changes per hour	23.7	Low	Low	Low	Low	0.75	Low	Low	0.75

Notes:

Main	Refers to main or upper deck of aircraft.
Fwd	Refers to forward belly compartment of aircraft.
Rear	Refers to rear belly compartment of aircraft.
Ctr	Refers to center belly compartment of aircraft.
Class B	Compartment accessible to crew members during flight.
Class C	Non-accessible compartment with an automatic fire extinguisher.
Class D	Non-accessible compartment with fire controlled by severely restricting oxygen supply.
Class E	Compartment not used for carrying passengers. Although compartment may be accessible during flight, no emergency oxygen is available.
B/E	Classification depends on configuration by aircraft owner.
NA	Compartment not available for animal transport.
Heating	Includes warm air, electric blankets and other methods.
Opt.	Available on some planes of this model.
Low	By definition, a class D compartment is airtight as a precaution against fire. However, there is usually some air exchange as compartment air leaks past door seals and is replaced. Quantity is difficult to predict.
@	No dedicated heating or cooling capability. Hot or cold air migrates from the passenger cabin into the main cargo deck.
#	Compartment incorporates a thermostatically controlled circulation fan.
*	Ventilation quantities available when cooling option is installed.

Table 2. Approximate Heat Production by Various Types of Animals

Animal	Individual weight lb	(kg)	Total heat produced Btu/hr/lb	Kj/hr/kg
Honey bee	--	(--)	100	222
Mouse	0.05	(0.02)	65	149
Baby chick	0.10	(0.05)	28	62
Hamster	0.24	(0.11)	34	74
Pigeon	0.61	(0.28)	38	84
Rat	0.66	(0.30)	34	76
Guinea pig	0.90	(0.41)	32	71
Chicken	2	(0.91)	15	33
Rabbit	6	(2.72)	20	44
Cat	7	(3.18)	19	42
Monkey	9	(4.08)	19	42
Dog	35	(15.88)	10	22
Goat	79	(35.83)	8	18
Sheep	99	(44.91)	10	22
Swine: Pig	25	(11.34)	9	20
Hog	550	(249.48)	7	16
Cattle: Calf	300	(136.08)	5	11
Cow	1,000	(453.60)	3	7
Horse	1,000	(453.60)	3	7
Human, adult	150	(68.00)	4	9

Note: These figures have been derived from a number of sources and may vary due to conditions such as humidity, temperature and stress level of the animals.

Sample calculation: To calculate the expected heat output for a load of 5,000 chicks, multiply 5,000 by 0.10 lb per chick. The resulting number (500 lb) is the total weight of the shipment. Multiply this by the heat output in the second column (28 Btu/hr/lb) to get the total heat output of the shipment, in this case 14,000 Btu's per hour. Shippers should communicate this information to carriers to insure that adequate ventilation/cooling will be available.

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